# Perchlorate Health Effects and Public Health Goal

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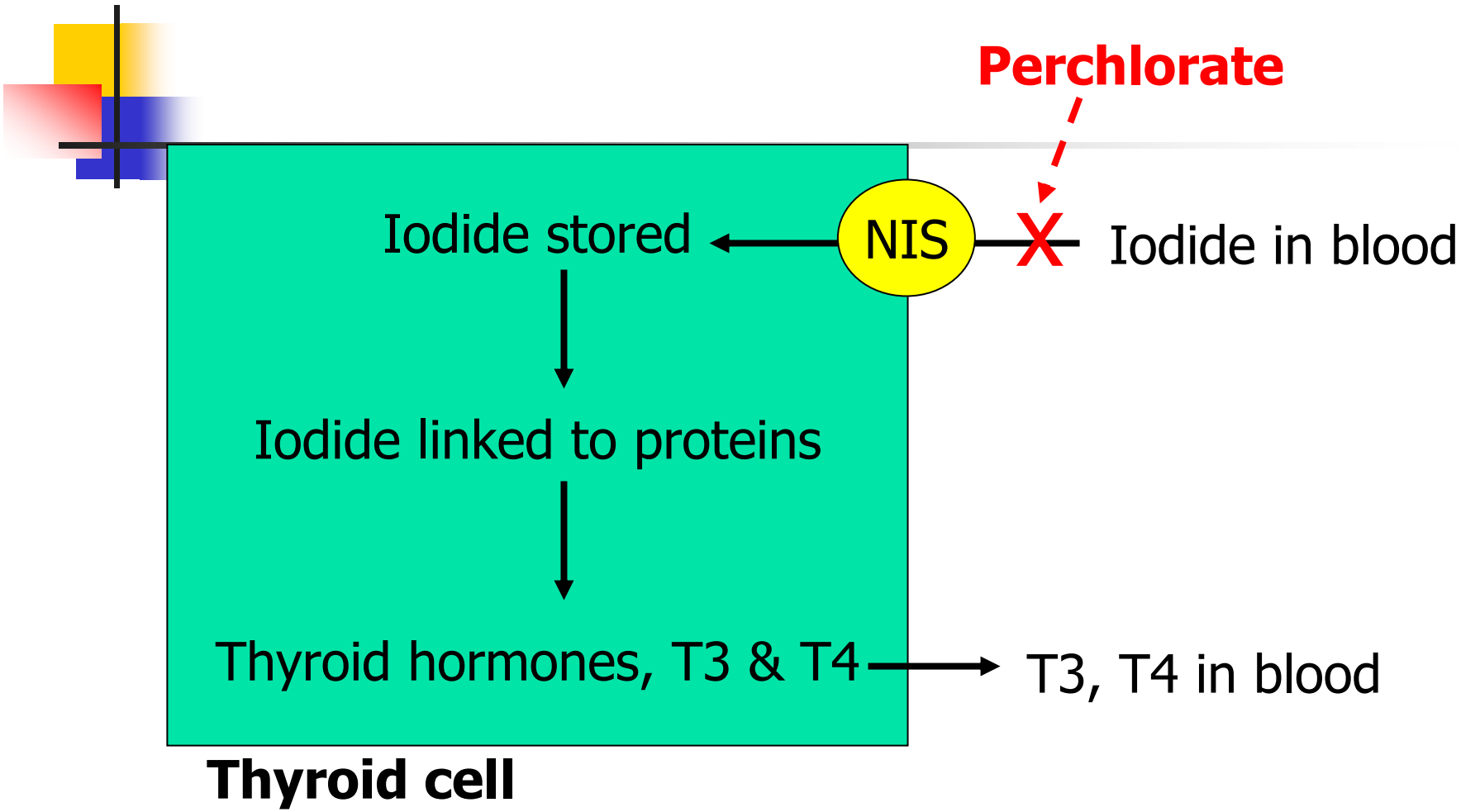
# Topics covered

- Mode of action of perchlorate
- Sensitive individuals
- Critical endpoint & human data
- Perchlorate Public Health Goal (PHG)
- State and Federal regulatory processes

# Mode of action of perchlorate

- Used as a drug to treat overactive thyroids
- Caused many adverse side effects
- At doses relevant to most environmental exposures, the main health concern is related to the disruption of thyroid hormone balance


Perchlorate
Iodide stored
NIS
X
Iodide in blood
Iodide linked to proteins
Thyroid hormones, T3 & T4
T3, T4 in blood
Thyroid cell

# Mode of action of perchlorate

- At a sufficiently high dose, perchlorate reduces iodide uptake into the thyroid
- Imbalance in iodide uptake and need causes depletion of stored iodide and thyroid hormones
- If this condition persists, perchlorate causes a decrease in thyroid hormone secretion

# Perchlorate causes thyroid hormone imbalance

- This in turn stimulates increase in serum TSH level
- Higher levels of TSH put stress on thyroid cells and cause them to increase iodide uptake, increase in size and number
- This leads to an increased secretion of thyroid hormones

# Issues considered

- Most people in California are iodine sufficient
- Healthy and balanced diet, use of iodized salt
- Consumption of food rich in iodine
- Adequate amount of iodide and thyroid hormones stored in the thyroid of adults

# Sensitive individuals

- Those who consume insufficient amount of iodine
- Pregnant women
- Lactating women
- Fetuses and infants
- Individuals with impaired thyroid function

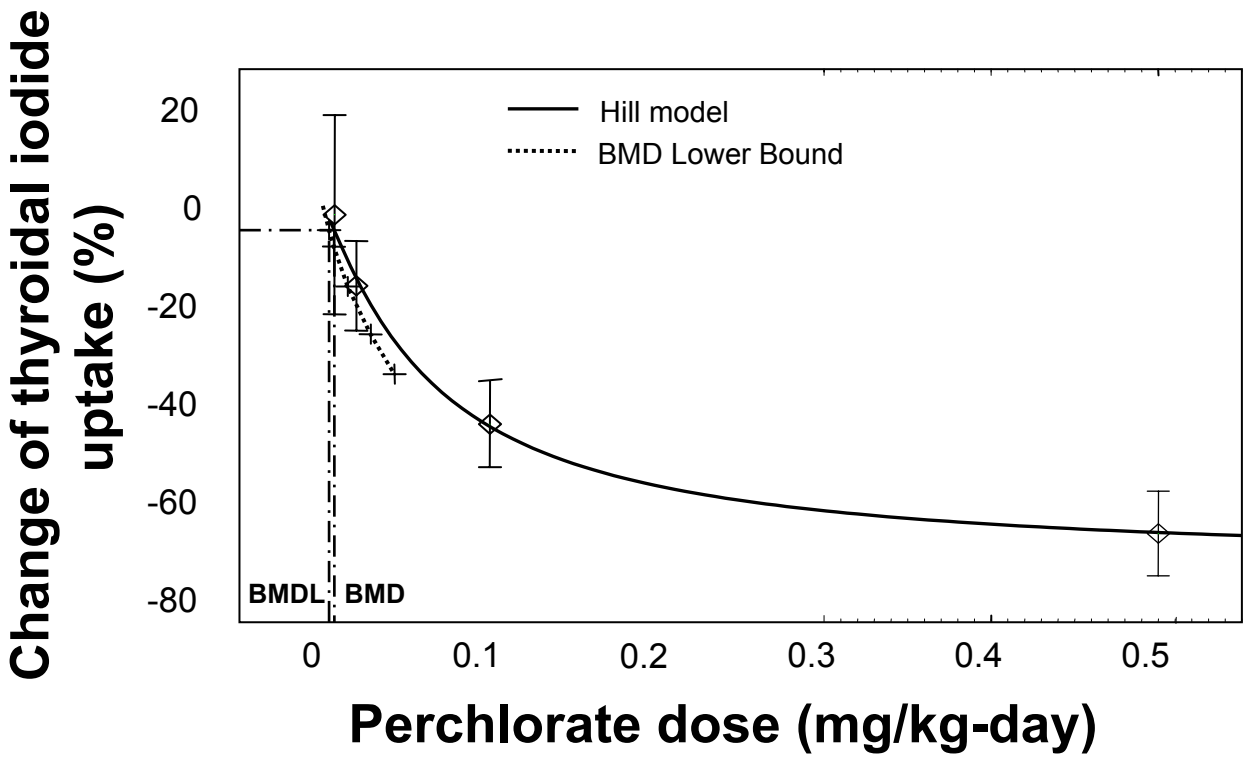
# Critical endpoint

- Minimize the inhibition of the sodium iodide symporter (NIS)
- Maintain the normal uptake of iodide into thyroid cells
- Prevent reduction of stored iodide and thyroid hormones
- Prevent reduction of thyroid hormone secretion and the associated effects

# Human data

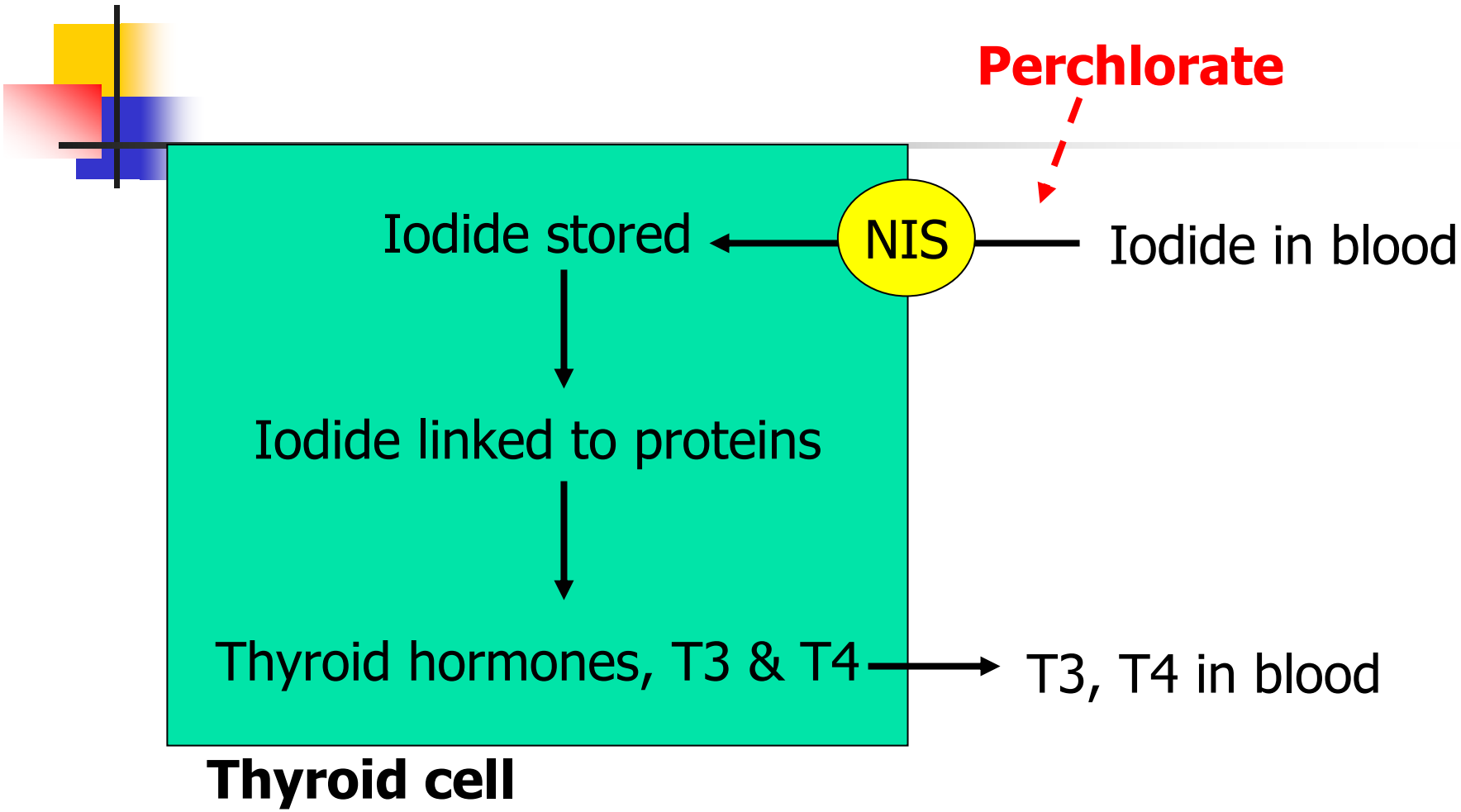
- 37 male and female volunteers dosed at 0.007, 0.02, 0.1, or 0.5 mg/kg-day through drinking water
- Radioactive $I^{123}$ uptake by the thyroid of each subject was measured before and at the end of the 14-day exposure period
- No change in serum T3, T4, and TSH

# Modeling of the human data reported by Greer *et al.* (2002)



# Issues considered

- Perchlorate is not metabolized by the body
- Over 85% of ingested perchlorate is excreted intact within 24 hours
- Reduction of iodide uptake into the thyroid is reversible in short-term studies
- Limited clinical and occupational study data do not show long-term effects with perchlorate exposure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# Calculation of perchlorate PHG

$$PHG = \frac{0.0037 \text{ mg/kg-day} \times RSC \times (BW/WC)}{UF}$$

$$= 6 \text{ µg/L or } 6 \text{ ppb}$$

RSC = 60%

BW/WC = 25.2 kg-day/L

UF = 10

# U.S. EPA risk assessment

- In a 2002 risk assessment, U.S. EPA proposed a drinking water level of 1 ppb or lower for perchlorate
- Mainly based on rat study results, also considered human data
- Used an overall UF of 300
- Currently under NAS review

# State and Federal regulatory processes on perchlorate

- State action level of 6 ppb
- State MCL within 1 year
- Federal MCL in 4 years?
- State MCL can be equal to or lower than the Federal MCL, but it cannot be higher than the Federal MCL

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**Useful websites:**

OEHHA: www.oehha.ca.gov

DHS: www.dhs.ca.gov/ps/ddwem/chemicals/chemindex.htm

U.S. EPA: www.epa.gov/safewater/mcl.html